310-11 SR
F213A XR 2,655,107

Oct. 13, 1953 N. H. GODBOLD 2,655,107

ELECTROMAGNETIC FLUID PUMP

Filed Sept. 1, 1950

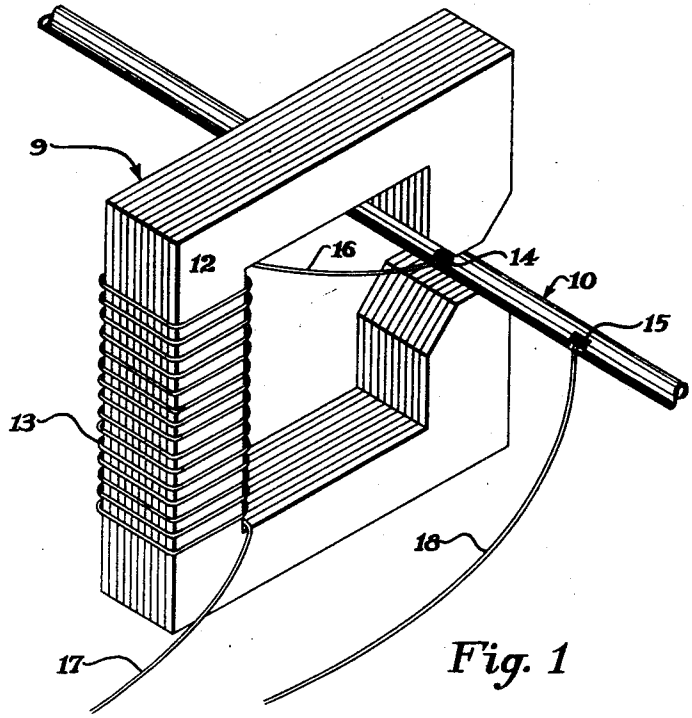


Fig. 1

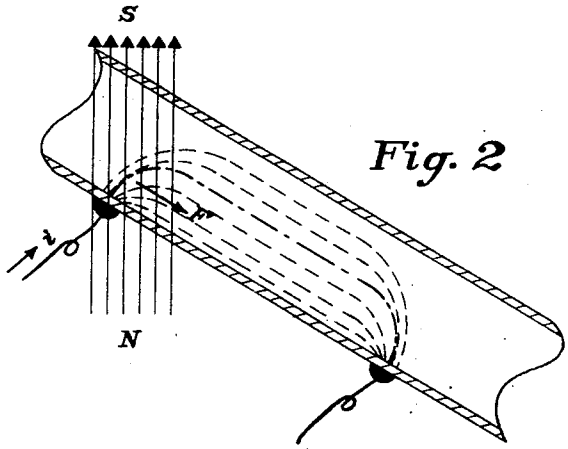


Fig. 2

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Patented Oct. 13, 1953

2,655,107

UNITED STATES PATENT OFFICE

2,655,107

ELECTROMAGNETIC FLUID PUMP

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Application September 1, 1950, Serial No. 182,833

3 Claims. (Cl. 103—1)

1

This invention relates to electromagnetic fluid pumps in which an electrically conducting fluid is impelled along a channel by the force which results from the reaction between an electric current passing through the fluid and an impressed magnetic field.

In general, the electromagnetic fluid pump is old in the art and is shown, for example, in Patent 2,397,785 to Freidlander and in Patent 1,286,644 to Chubb. Such pumps of the prior art develop an impelling pressure head by the reaction between an electric current passing through the fluid normal to the direction of fluid flow and an externally impressed magnetic field. This arrangement requires the use of fluid contacting conductors on opposed edges of the fluid duct.

In certain applications the use of a fluid duct having opposed electrical connections is awkward and involves unnecessary complexity in arrangement. Hitherto it was accepted as a basic necessity in electro-magnetic fluid pumps that the connections to the fluid must be across opposed sides of the fluid duct in order that the resulting current will have a component direction perpendicular to the direction of fluid flow.

The present invention is predicated upon the discovery that the connections to the conducting fluid in an electromagnetic fluid pump can be affixed with a longitudinal separation to one side of the duct. Such an arrangement has a number of advantages. One advantage lies in the choice of spacing between the connections to the fluid or to the fluid duct so as to obtain a more efficient coupling between the load and energization source impedences. Further, it is feasible with a pump fabricated in accordance with the teachings of this invention, to support a plurality of fluid ducts on a supporting wall or bulkhead and detachably support the magnetic structure so as to straddle the duct. Such an arrangement would involve a number of complexities in mounting the ducts of the prior art due to interference with the leads on at least one side of the duct.

It is accordingly a primary object of this invention to provide an electromagnetic fluid pump of simpler construction and more efficient operation than those hitherto known.

Other objects and advantages will appear from a description of a preferred embodiment of the invention illustrated in the drawings accompanying and made a part of the specification.

In the drawings:

Figure 1 is a perspective view of a preferred embodiment of the invention.

2

Figure 2 is a chart showing the vector relationship between the current in the fluid and the impressed magnetic field of the embodiment of Figure 1.

Referring to Figure 1, the electromagnetic fluid pumps arranged in accordance with this invention comprises two main parts, which are the magnetic assembly 9 and the fluid duct 10. The magnetic assembly can be either a permanent magnet or an electromagnet and it is preferably an alternating current electromagnet. To this end the core 12 is of laminated magnet steel construction. An energizing coil 13 surrounds at least one leg of the core.

In order to produce a flow force on a conducting liquid in duct 10, a pair of contacts 14 and 15 are provided. These contacts penetrate the duct if the duct is of dielectric material, or are simply connected to the outside surface if the tube is of conducting material. It has been found that thin non-magnetic high electrical resistivity metal such as stainless steel is preferred for the fluid duct.

The electrical circuits for either direct or alternating source energization are completed by connecting one lead 16 of the electromagnet coil to one of the duct contacts. In the drawing this connection is to contact 14. The remaining lead 17 of the electromagnet coil 13 is adapted for connection to an energization source. For convenience in completing the electrical circuit a lead 18 is connected to fluid duct contact 15.

Although the principles of operation is not known for certain, it seems reasonable to assume that the current in the fluid diverges from contact 14 and consequently establishes a component of current flow which is normal to the direction of migration of the fluid. This assumption appears sound in that it has been found that optimum pumping action is obtained if the contact 14 under the pole piece is in the middle of the magnet field and the remaining contact 15 is well away from the magnet field. The geometry of the magnetic field and electric current in the fluid is shown substantially in Figure 2. The dash lines represent the electric current flow in the liquid. The dash-dot lines represent the equivalent single current. Under the conditions shown, with the current entering the left hand end of the current path, and with a magnetic flux having poles as indicated by N and S it is seen that the reaction force F is to the right and that the fluid will be impelled from left to right. It is understood that the direction of current flow and direction of magnetic flux are matters of selection to be exercised by those

skilled in the art to suit any particular pumping problem.

An electromagnetic device has been thus far described as a pump, but it is to be understood that it has the characteristic of reversibility. That is to say, if no potential is applied to the fluid or fluid duct, and the fluid is propelled, a potential appears between the connections which is substantially proportional to the rate of flow. It follows that the device is adapted to be used either as a pump or a flow meter.

An electromagnetic fluid pump has herein been described with reference to what is considered to be the best embodiment thereof, but it is to be understood that the apparatus shown is only illustrative and that the invention can be carried out by other means. The invention is therefore to be limited only by the limitations of the accompanying claims when interpreted in view of the prior art.

What is claimed is:

1. An electromagnetic fluid pump comprising a magnetic structure having opposed pole pieces and a fluid duct, means for supporting said fluid duct between said pole pieces, first means for connecting the terminal of an electric energy source to said duct between the pole pieces, and second means for connecting the other terminal of the electric energy source to the fluid duct remote from said pole pieces at a position on the perimeter of the duct similar to that of the first means.

2. An electromagnetic fluid pump comprising an electro-magnetic structure having a pair of pole pieces and a fluid duct, means for supporting said fluid duct between said pole pieces, a connection to said fluid duct under said pole pieces, a second connection to said fluid duct on the same side of said fluid duct and longitudinally spaced from said first connection, a winding on said electromagnetic structure, means for connecting one end of said winding to one of said fluid duct connections and means for connecting an electrical energy source between the other end of the electromagetic coil and the other fluid duct connection.

3. An electromagnetic reaction device comprising a fluid duct, means for traversing said fluid duct with a magnetic field, means for establishing an electrical circuit across a length of the fluid in the longitudinal direction of said duct between a first point traversed by the magnetic field and a second point on the fluid duct remote from the magnetic field.

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